Assimilation of Different Versions of CYGNSS L2 Wind Speed Data for Hurricane Florence (2018)

Xuanli Li[1], Jason B. Roberts[2], and John R. Mecikalski[1]

[1]University of Alabama in Huntsville

[2]NASA Marshall Space Flight Center

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THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

1. Compare CYGNSS v3.1b and v3.0 wind speed data for Hurricane Florence (2018)

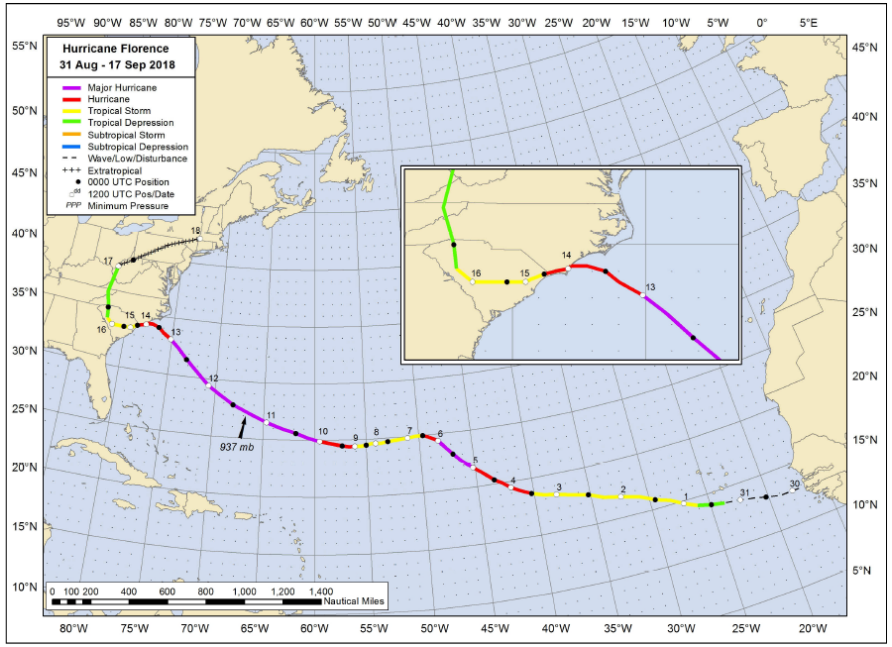
2. Assimilate v3.1b YSLF, v3.0 L2 YSLF wind speed data

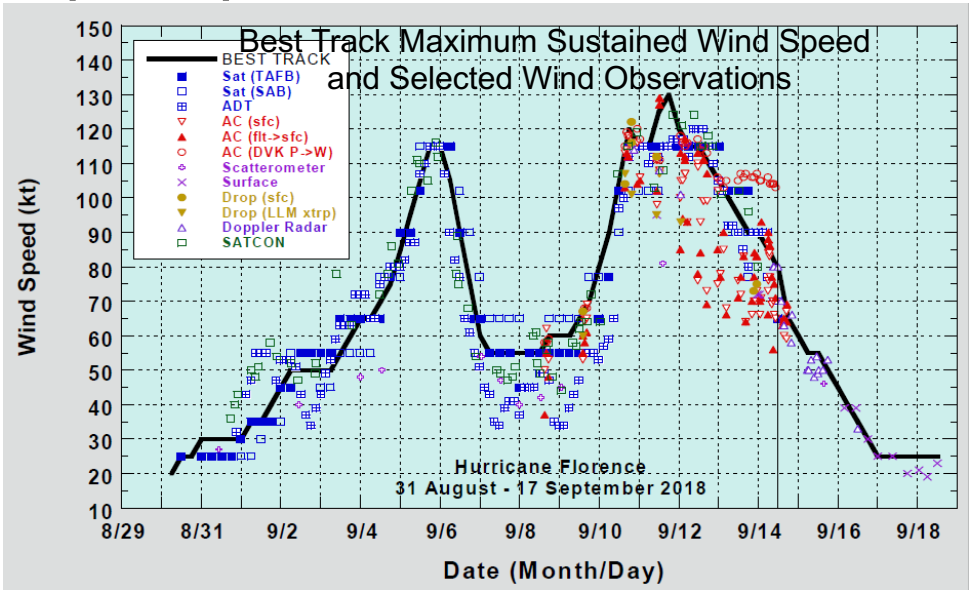
3. Examine the impact of CYGNSS data on forecasts of Hurricane Florence

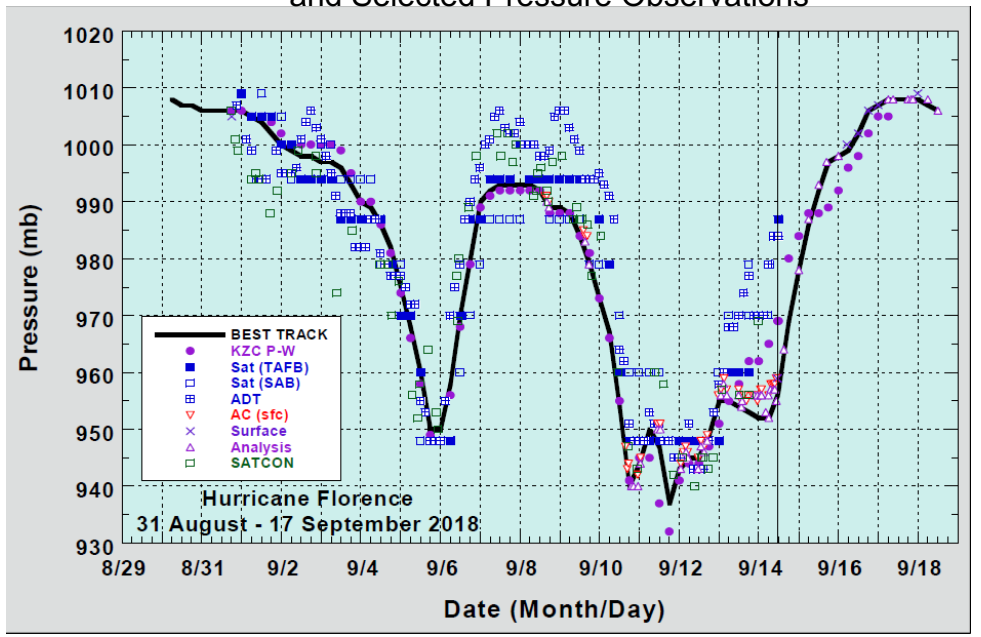
YSLF – "Limited Fetch" Geophysical Model Function (GMF) used for Young Seas
FDS – "Fully Developed"

Hurricane Florence (2018)

- Long-lived category-4 Hurricane
- Caused 22 direct and associated with 30 indirect fatalities
- Made landfall at North Carolina as a cat-1 Hurricane
- Storm surge flooding in eastern North Carolina
- Devastating freshwater flooding in southeastern US

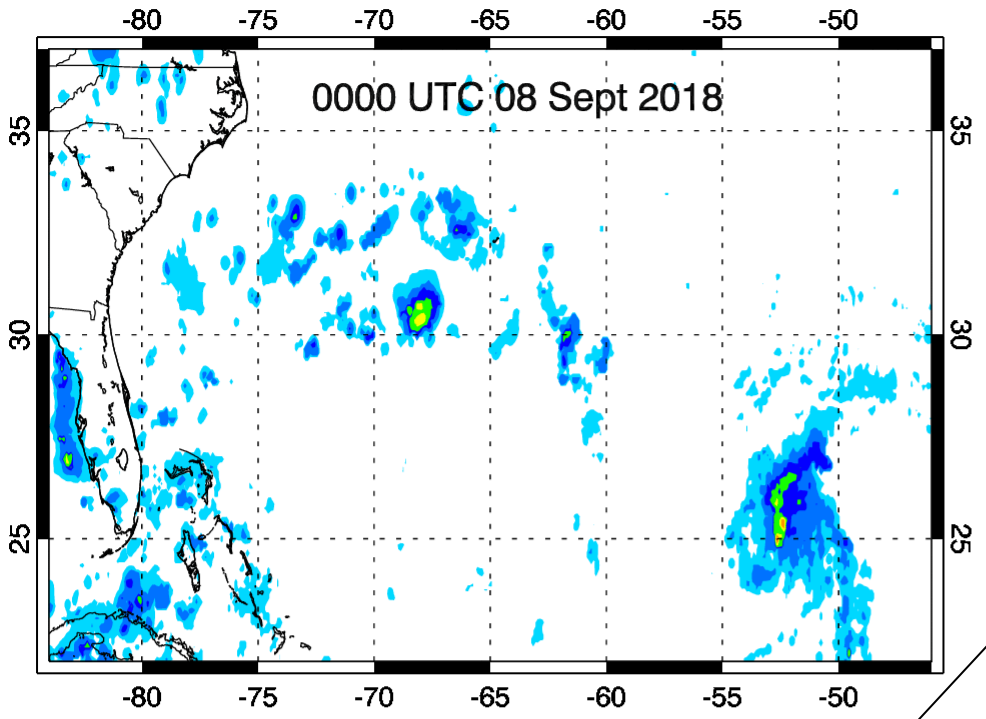




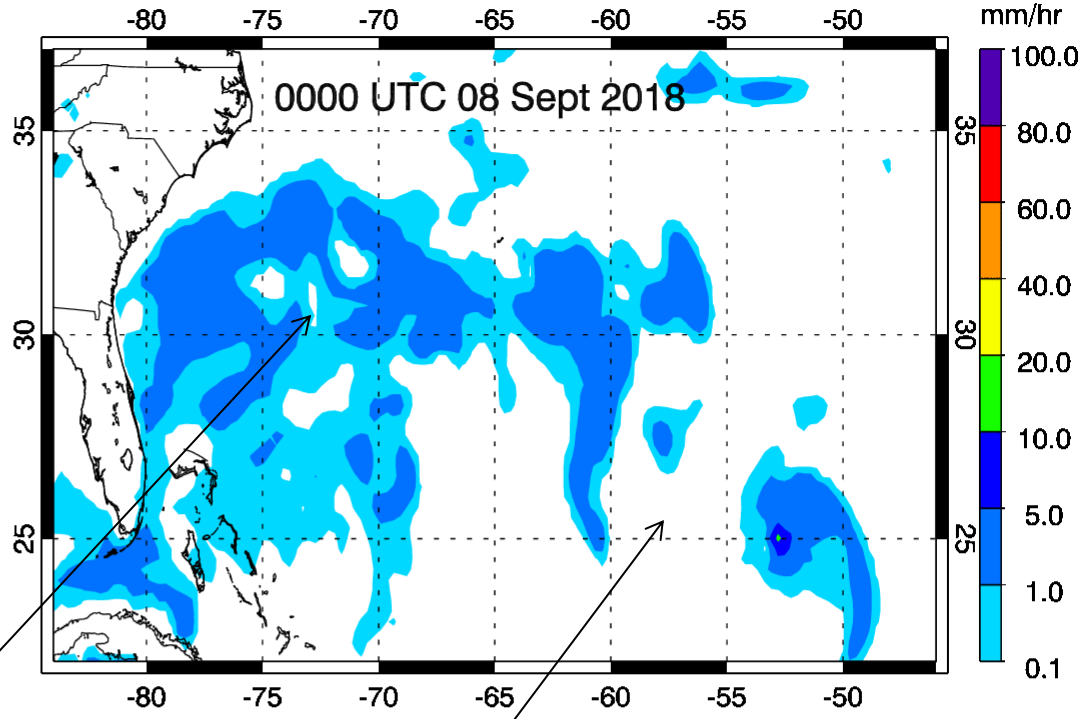


Model Domain and WRF Simulation

IMERG Surface Precipitation Rate



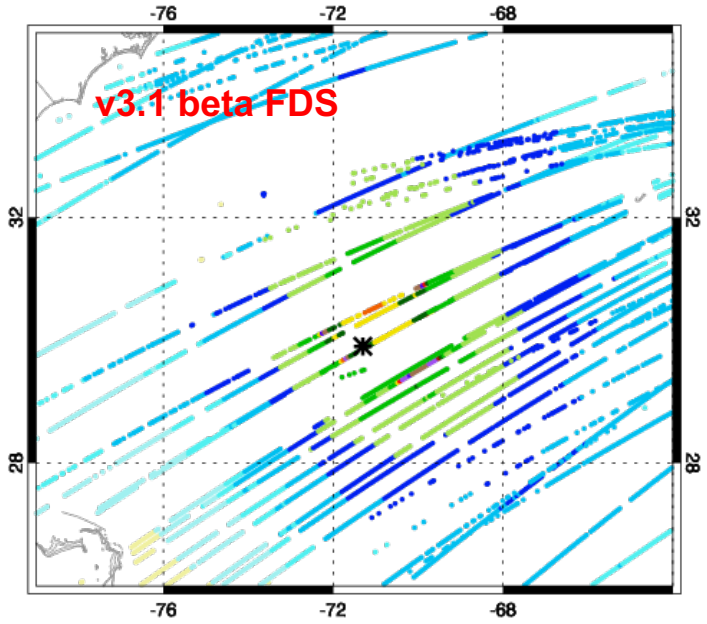
WRF Forecast 1-h precipitation

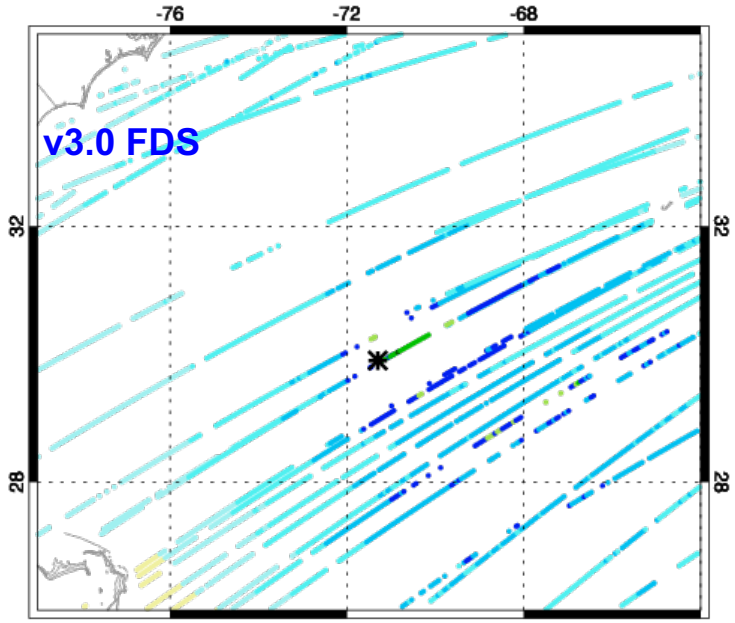


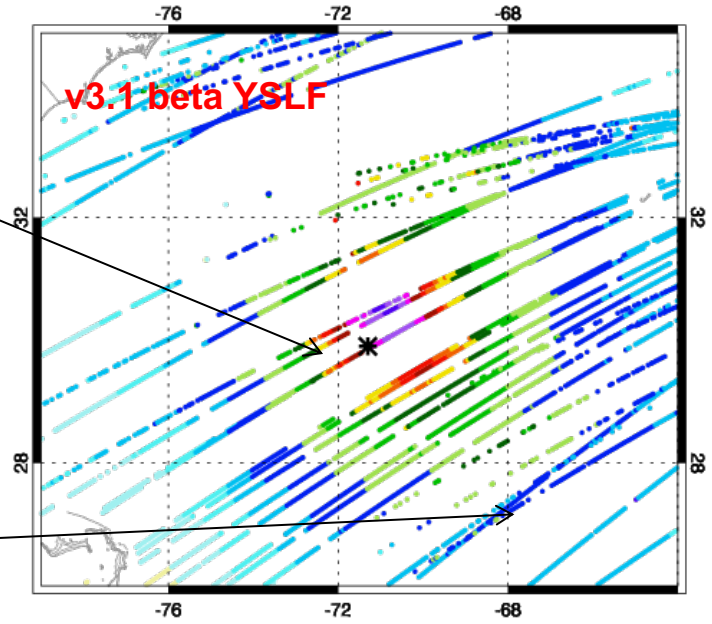
Misplacement of storm location

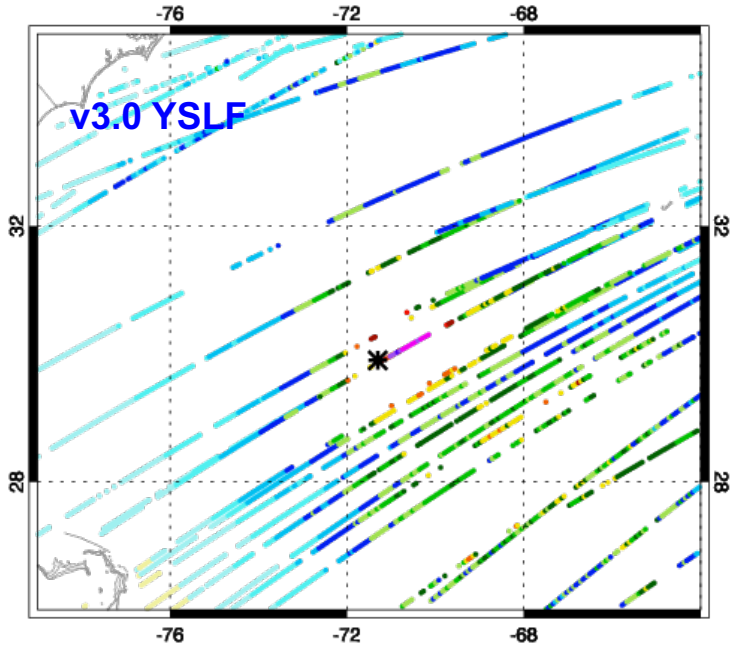
Weaker intensity and precipitation around Hurricane Florence

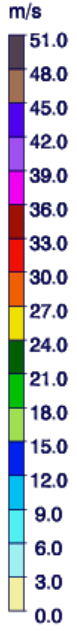
CYGNSS Level 2 Wind Speed Data – v3.0 vs. v3.1 beta











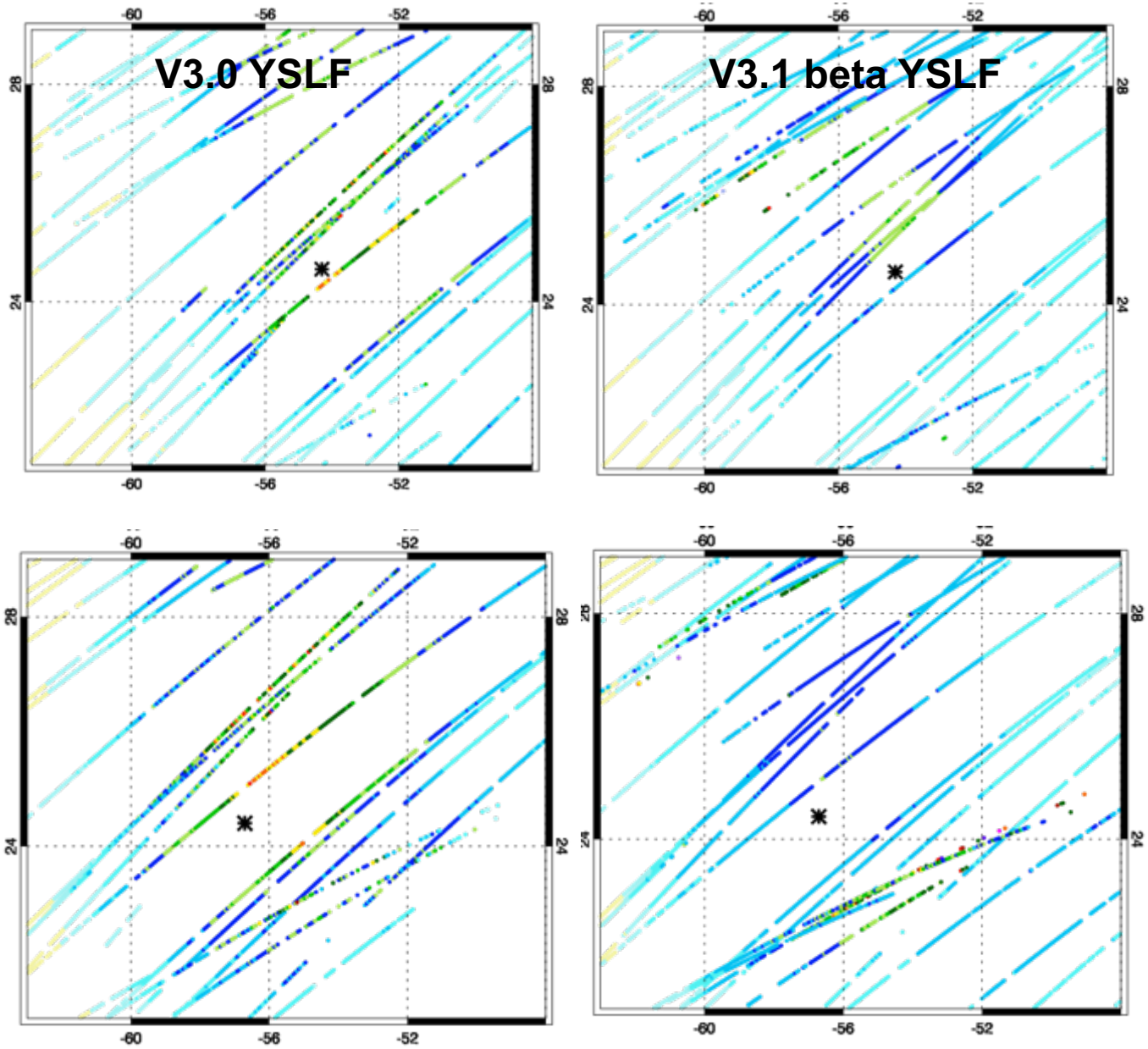
Stronger winds with better wind structure around storm center

Weaker winds

* Observed storm center

± 1.5 h from 15 UTC 09/12/2018

CYGNSS v3.0 YSLF vs. v3.1 beta Wind Speed

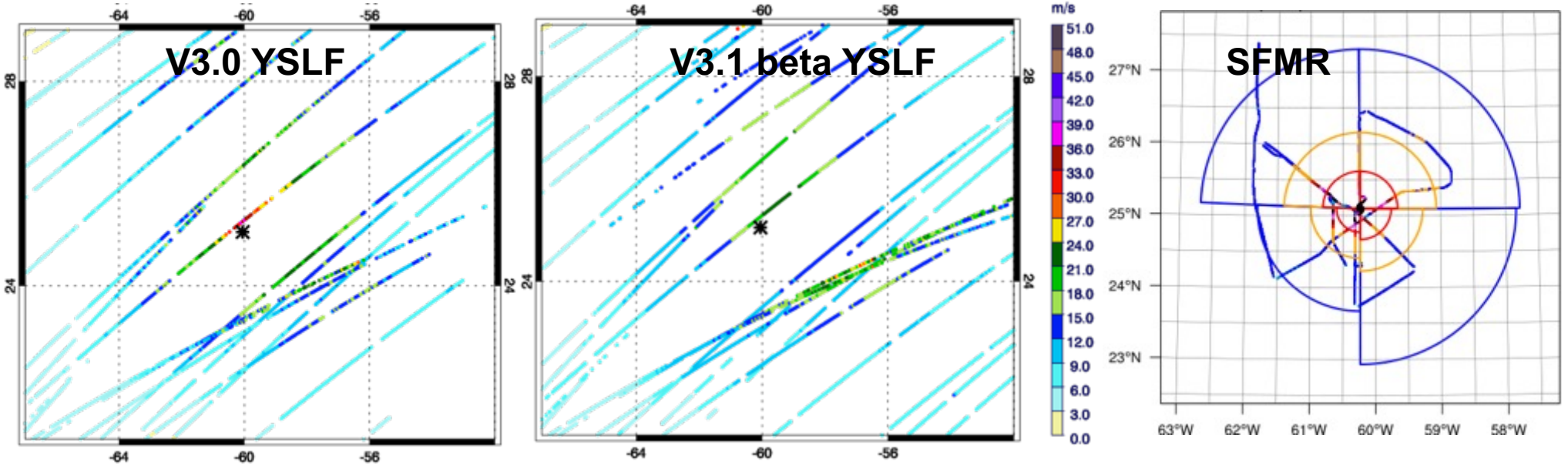


15 UTC 2018/09/08
Best Track Vmax = 28 m/s

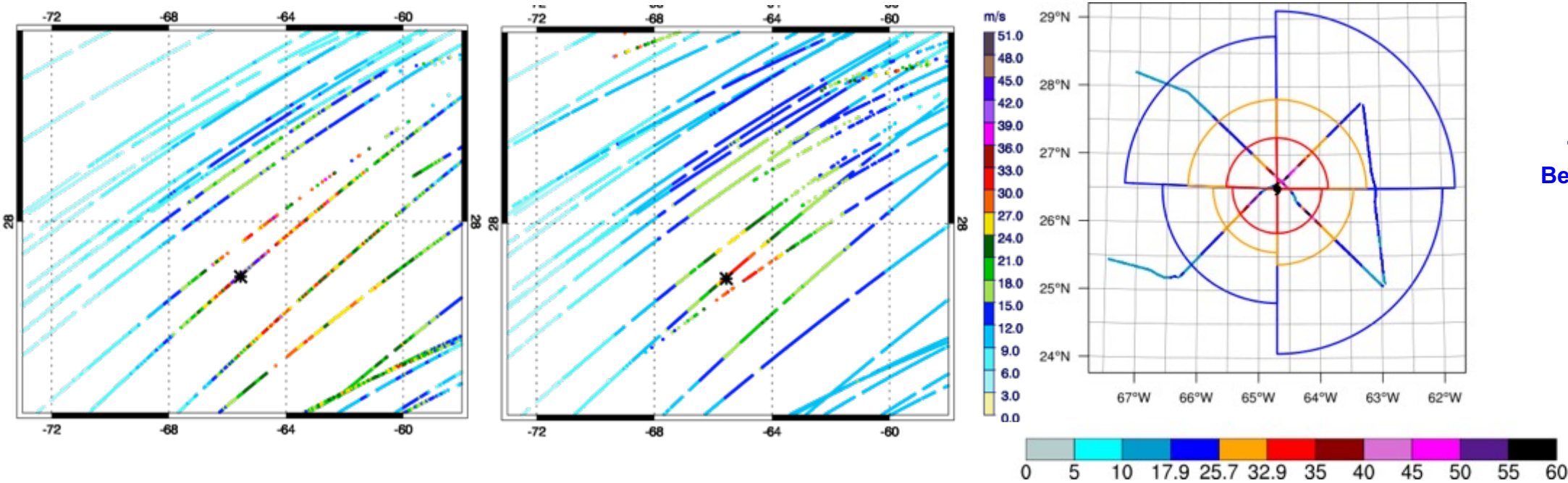
Weaker winds in v3.1b

15 UTC 2018/09/09
Best Track Vmax = 36 m/s

CYGNSS v3.0 YSLF vs. SFMR Wind Speed

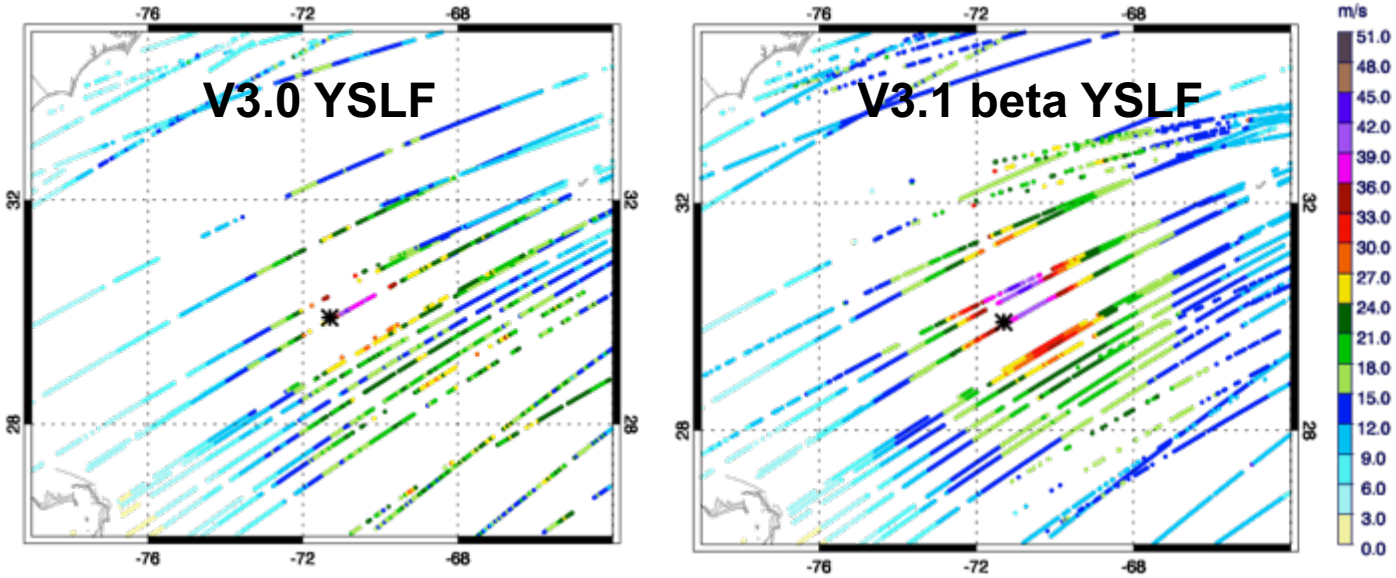


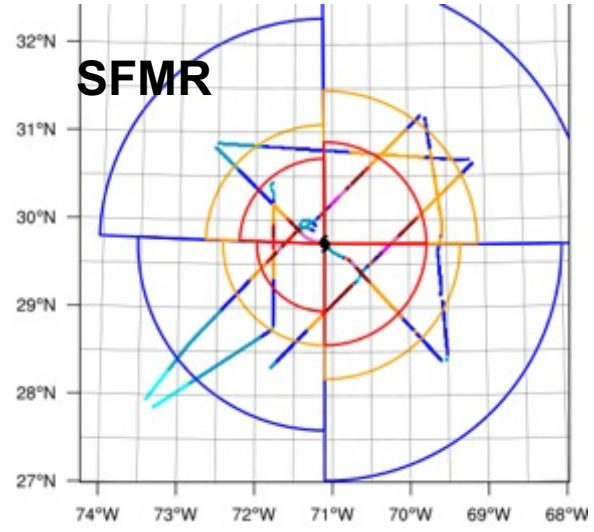
15 UTC 2018/09/10
Best Track Vmax = 54 m/s



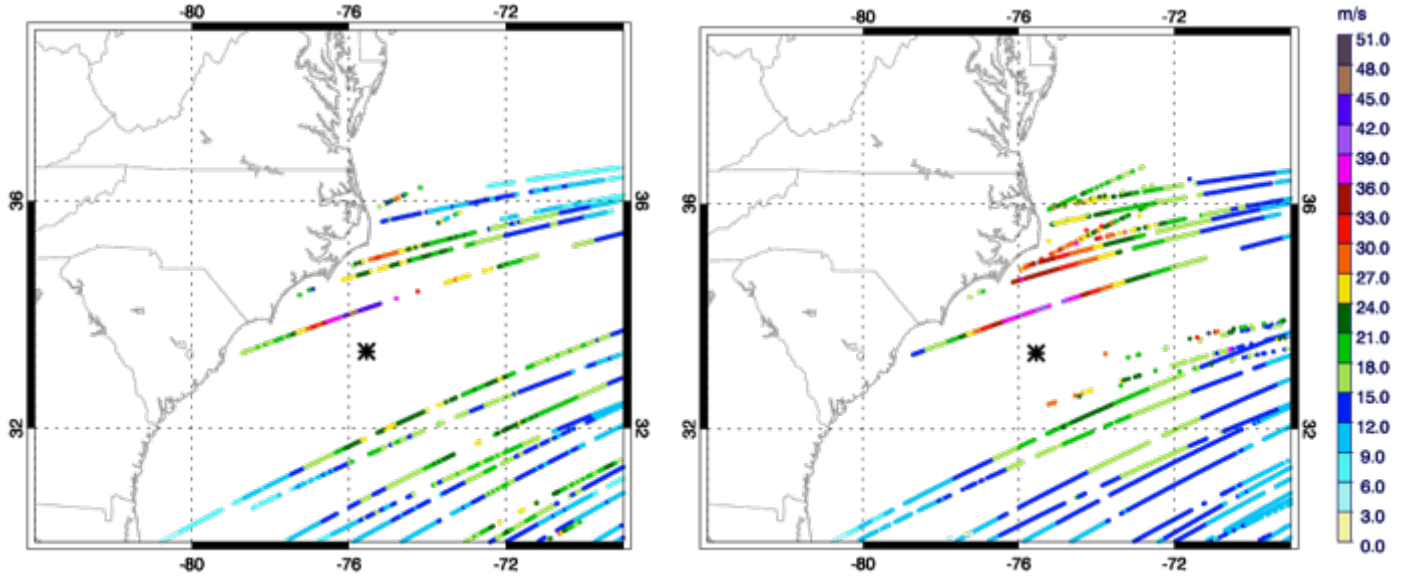
15 UTC 2018/09/11
Best Track Vmax = 66 m/s

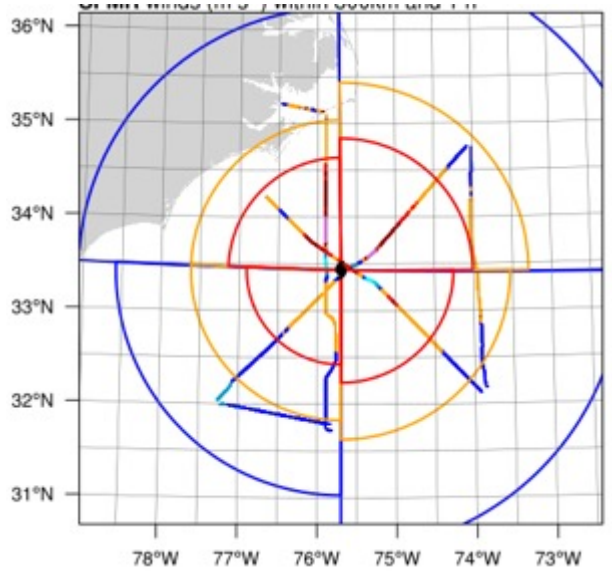
CYGNSS v3.0 YSLF vs. SFMR Wind Speed



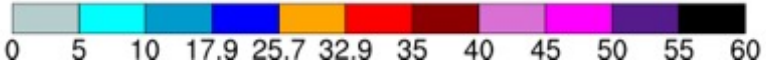


15 UTC 2018/09/12
Best Track Vmax = 59 m/s



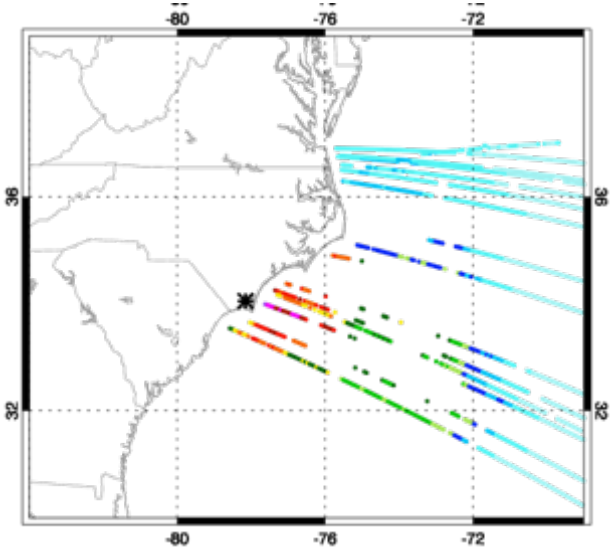


15 UTC 2018/09/13
Best Track Vmax = 49 m/s

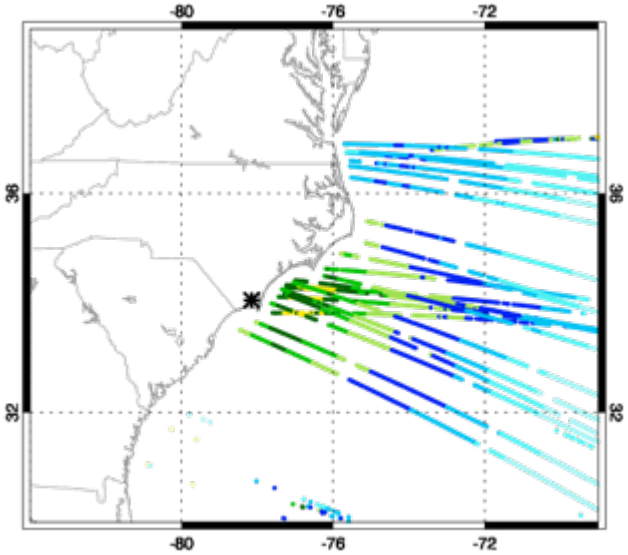


CYGNSS v3.0 YSLF vs. SFMR Wind Speed

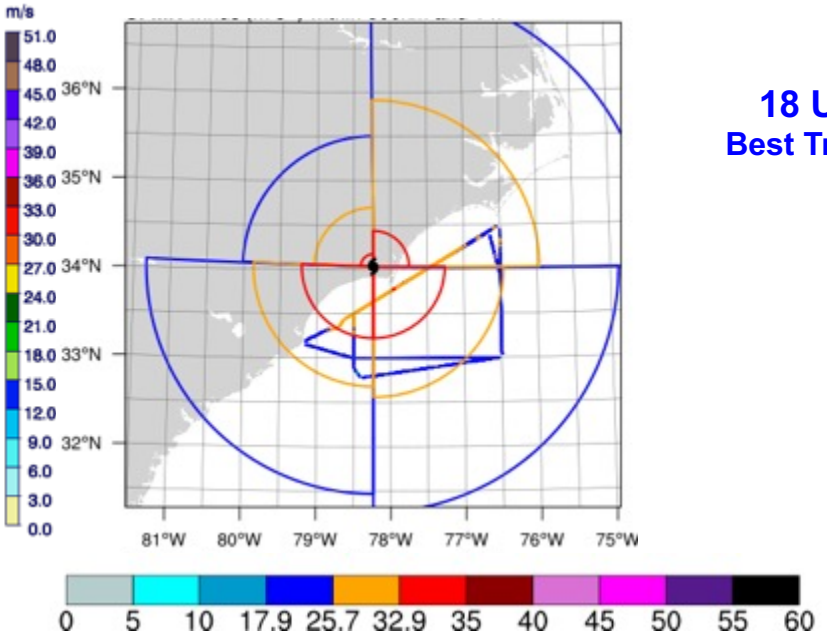
V3.0 YSLF



V3.1 beta YSLF



SFMR



18 UTC 2018/09/14
Best Track Vmax = 37 m/s

Numerical Experiments

WRFDA hybrid En3dvar

WRF Model Simulation: 00 UTC 8 September – 00 UTC 15 September 2018

Data: CYGNSS v3.1b and v3.0 L2 wind speed wind speed

Typically available for Hurricane Florence at 15-21 UTC each day

Focus: Continuous assimilation of CYGNSS L2 wind speed data

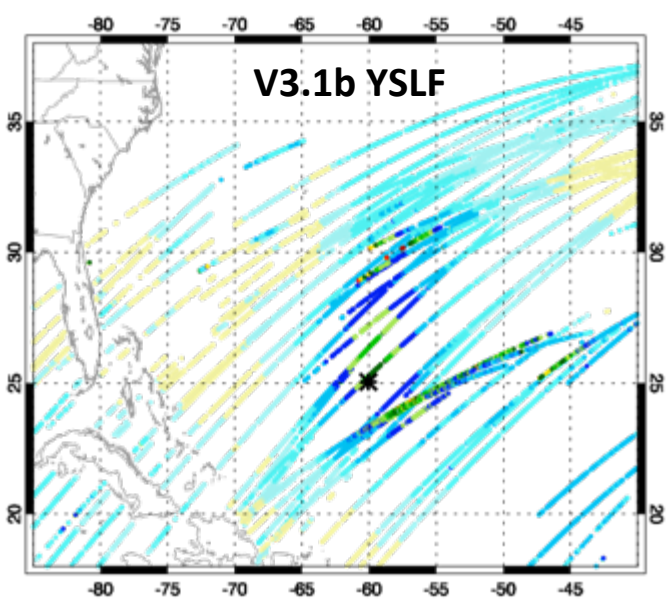
Observational error: 2 m/s for windspeed < 20 m/s or windspeed uncertainty < 3.5

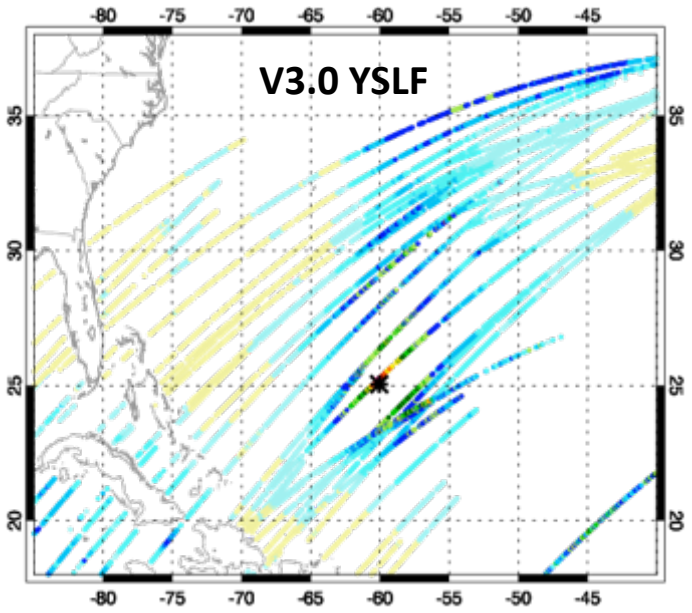
5 m/s for windspeed > 20 m/s or uncertainty > 3.5

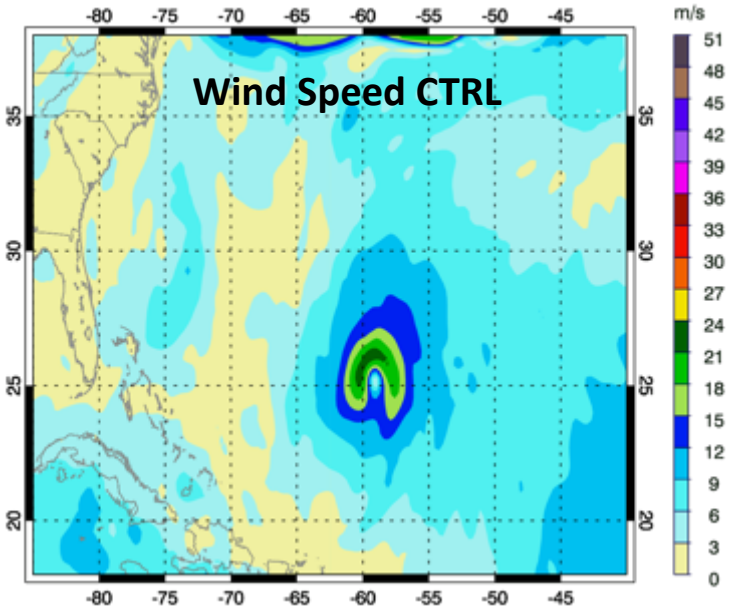
Experiments	Data Assimilation
CTRL	No
DA_yslf_v3.1b	CYGNSS v3.1b YSLF wind speed at 15, 18, and 21 UTC 8 – 14 September 2018
DA_yslf	CYGNSS v3.0 YSLF wind speed at 15, 18, and 21 UTC 8 – 14 September 2018
DA_yslf_v3.1b_4dvar	CYGNSS v3.1b YSLF wind speed 4dvar assimilation at 14-16 and 18-21 UTC 8 – 14 September 2018

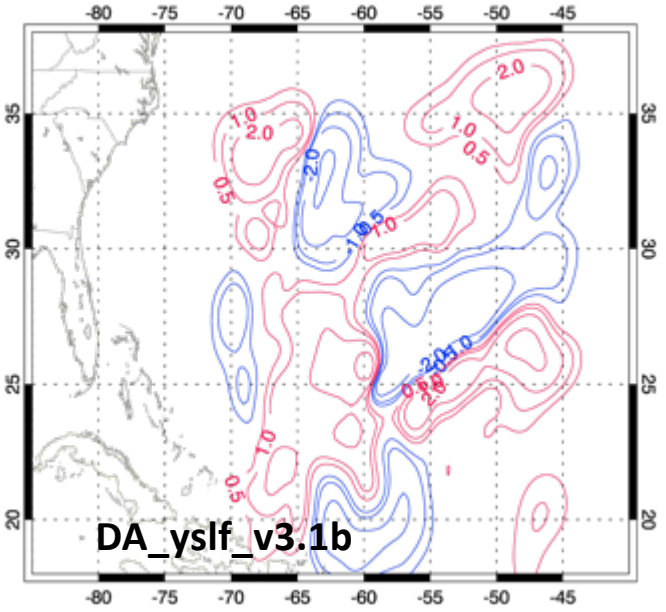
CYGNSS Data Assimilation Analysis Increment

7th DA cycle
1500 UTC 10 September 2018

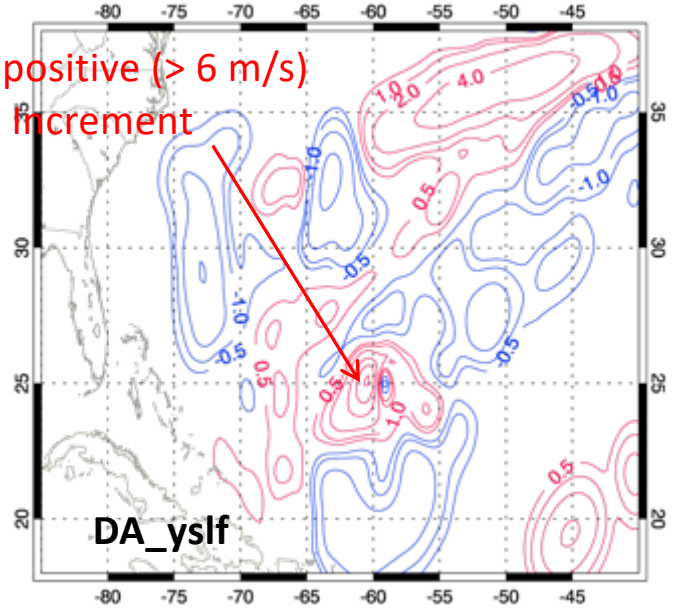


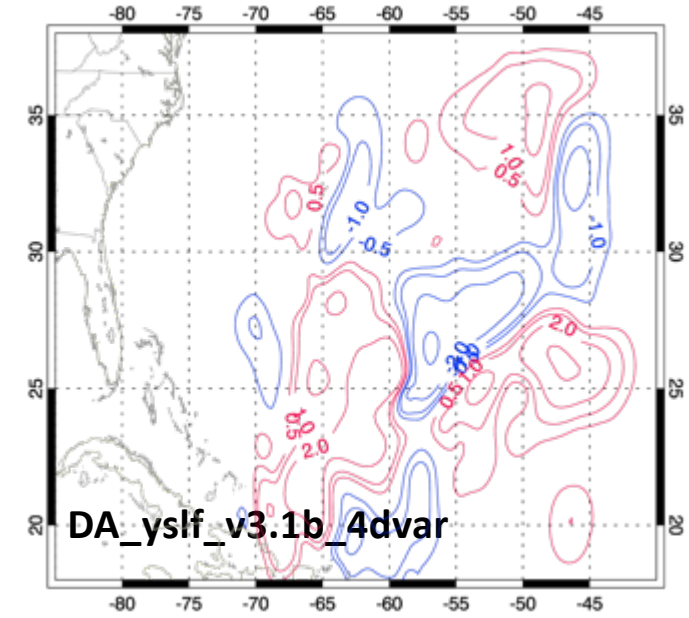




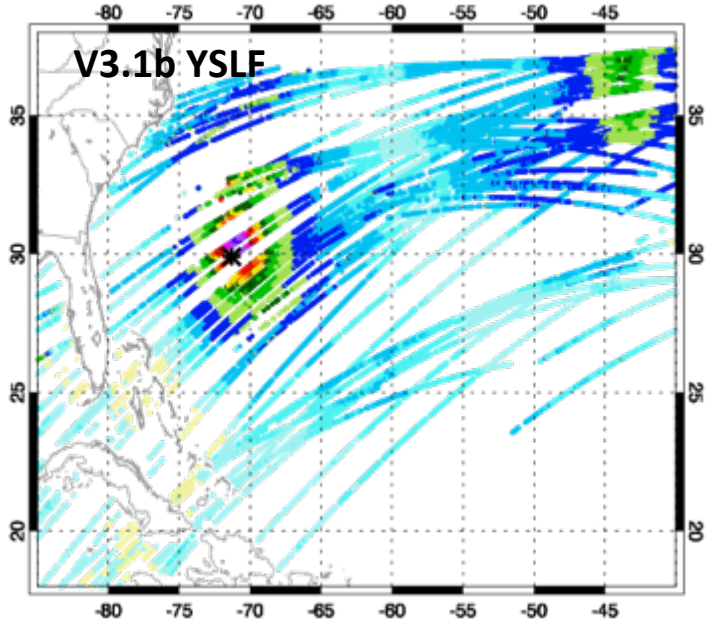


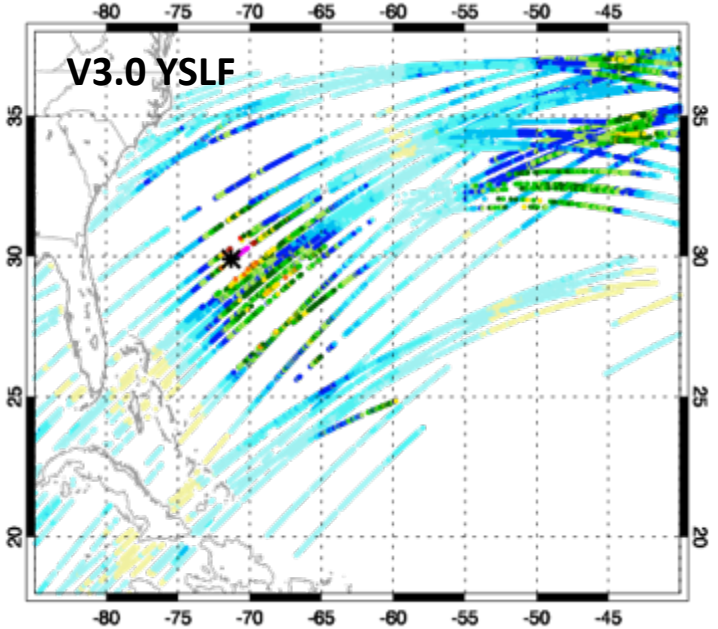
Large positive (> 6 m/s) increment

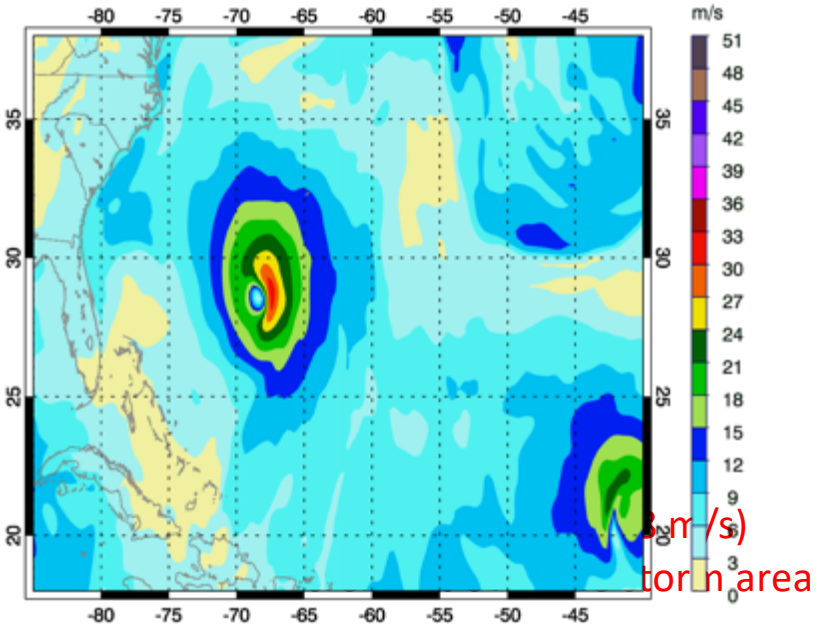




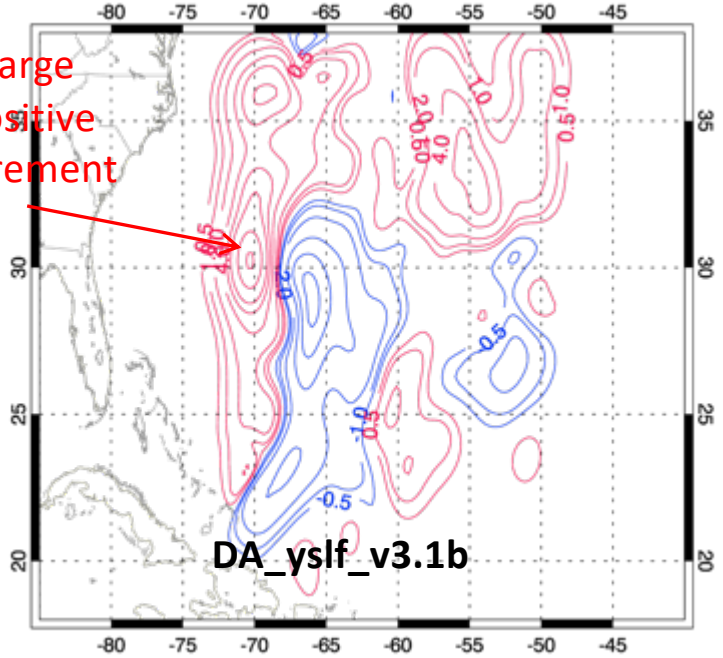
CYGNSS Data Assimilation Analysis Increment

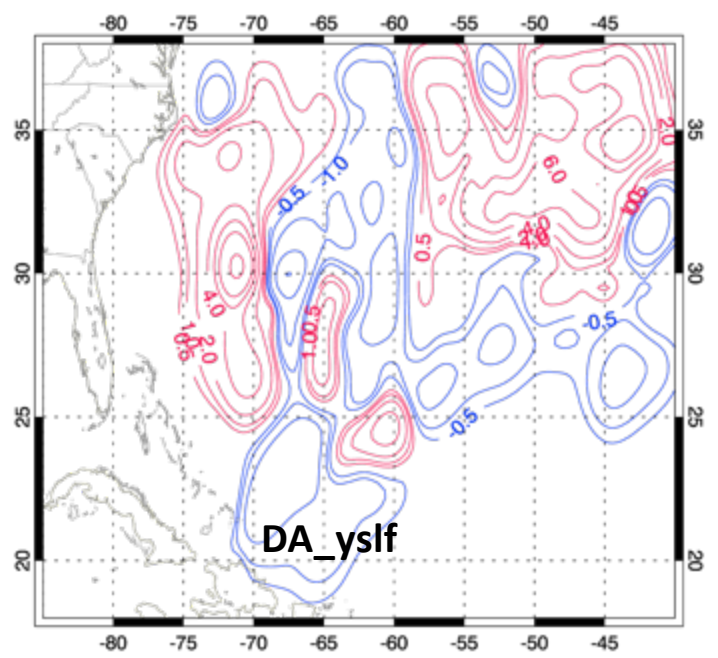


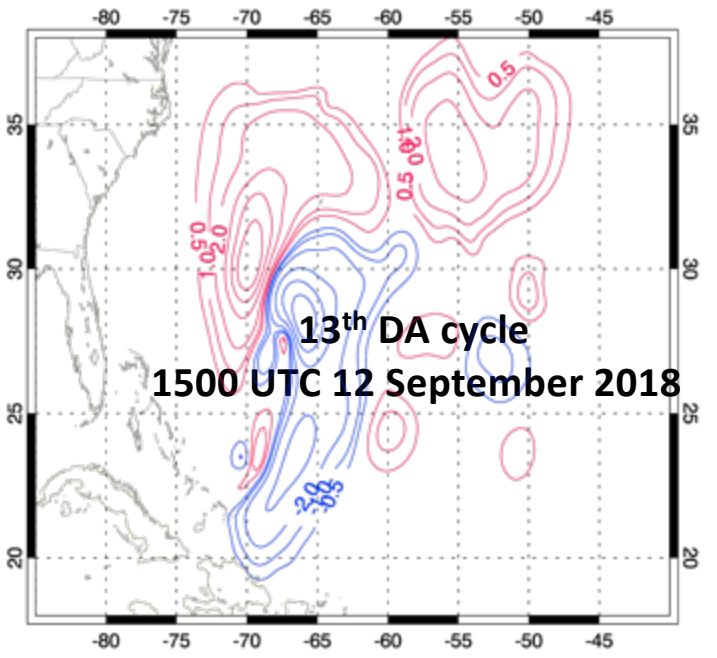




Large positive Increment

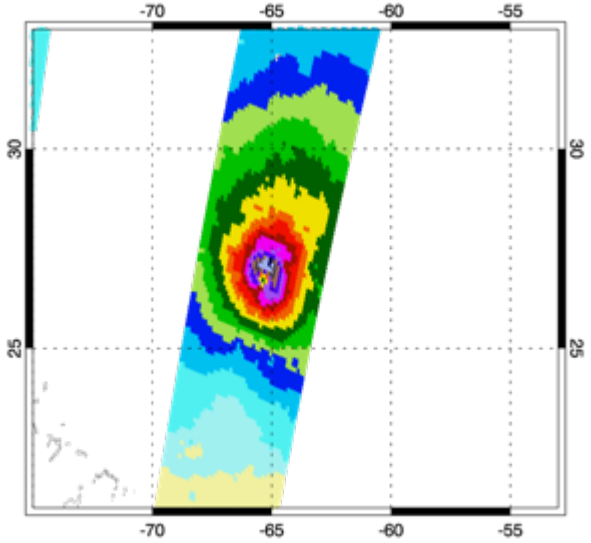




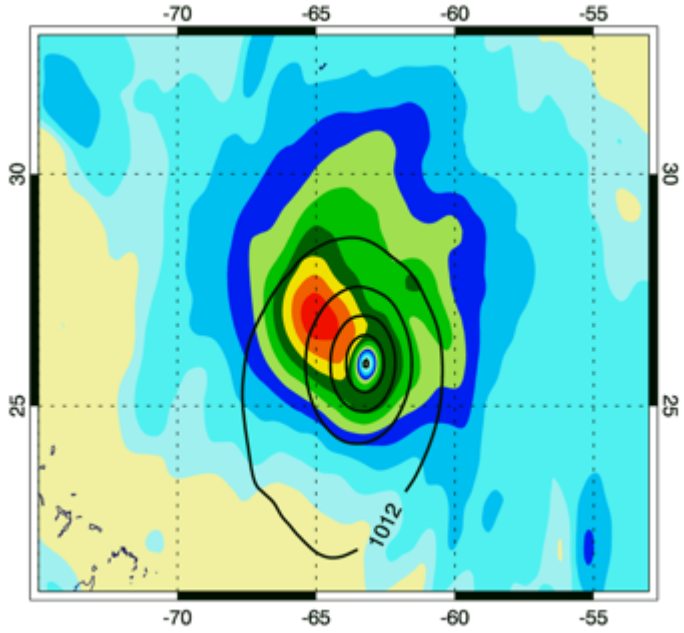


Data Impact – Surface Wind Field

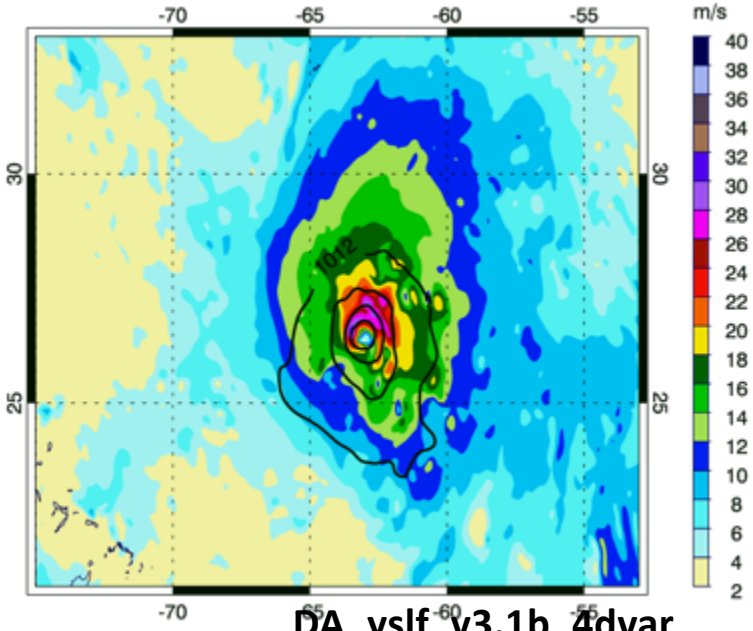
ASCAT
1230 UTC



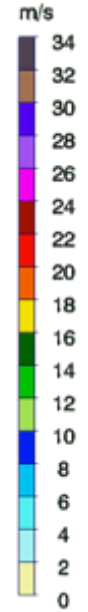
1200 UTC
11 September 2018



DA_yslf_v3.1b

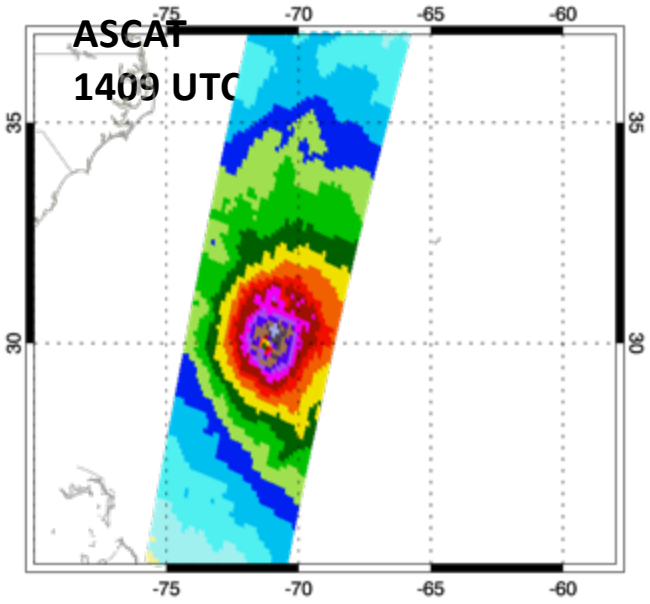


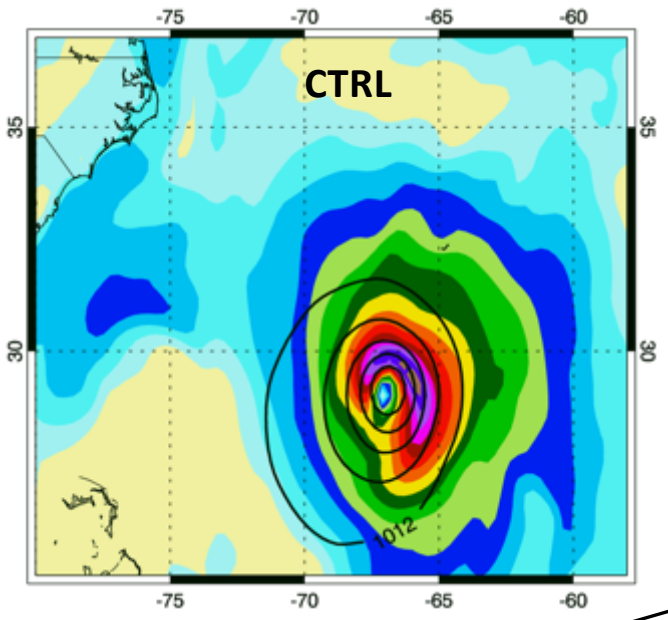
DA_yslf_v3.1b_4dvar



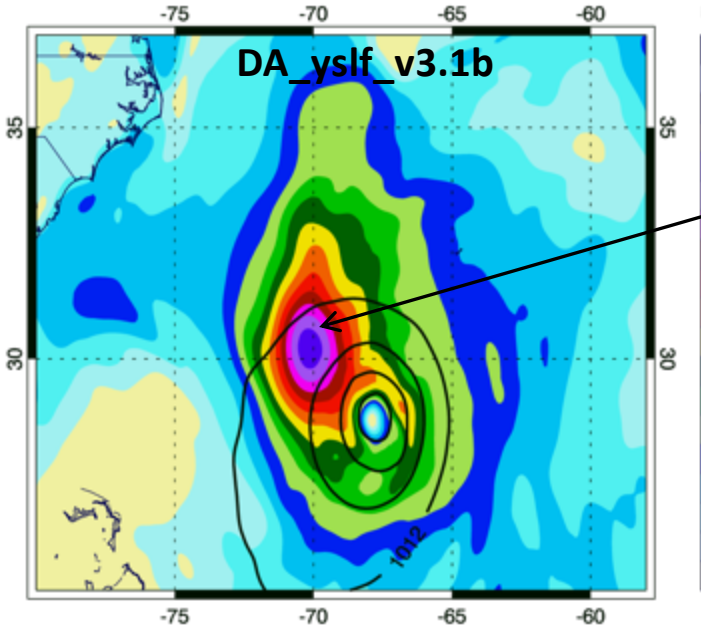
Data Impact – Surface Wind Field

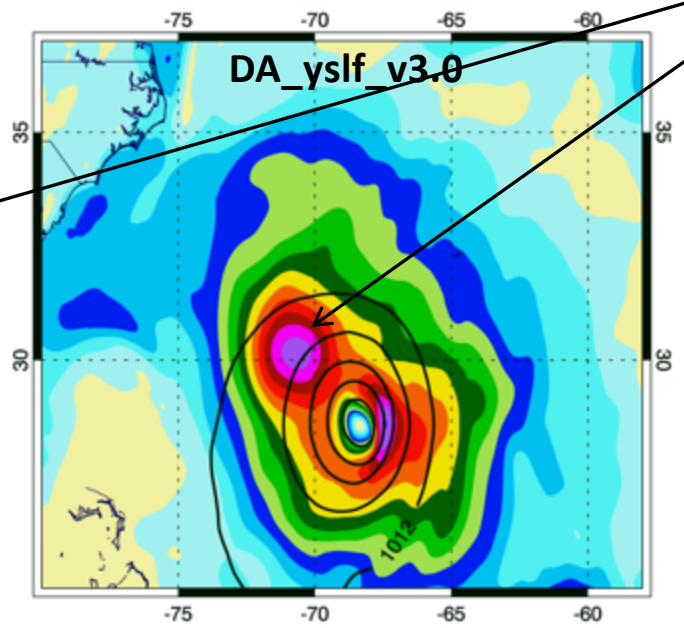
1500 UTC
12 September 2018

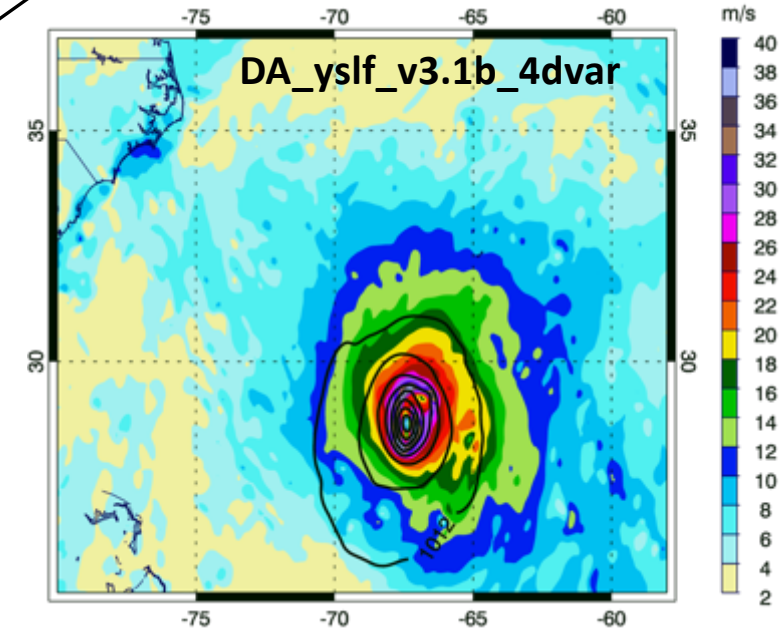


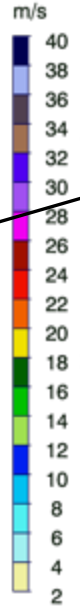


High winds around the observed storm center

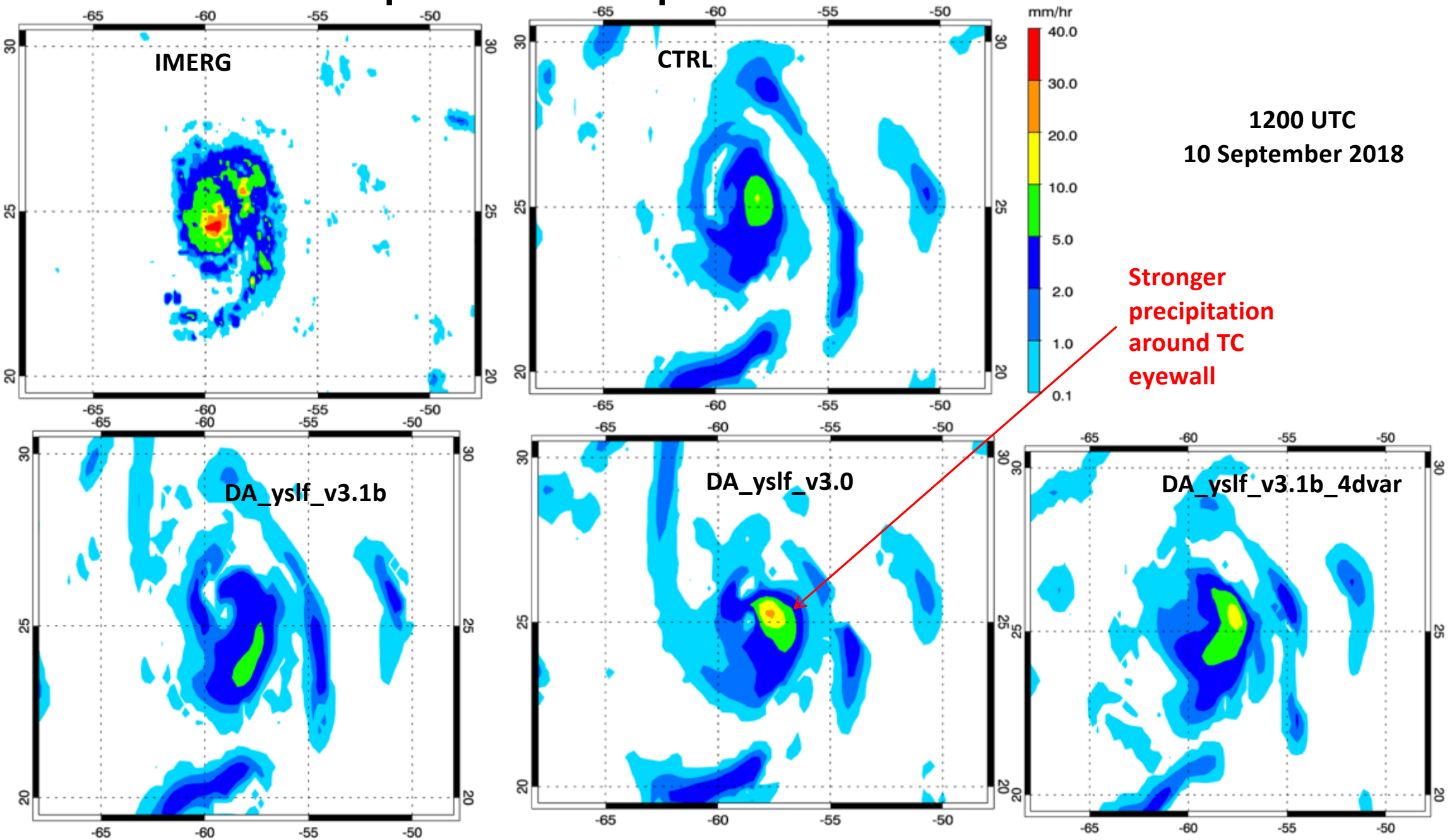




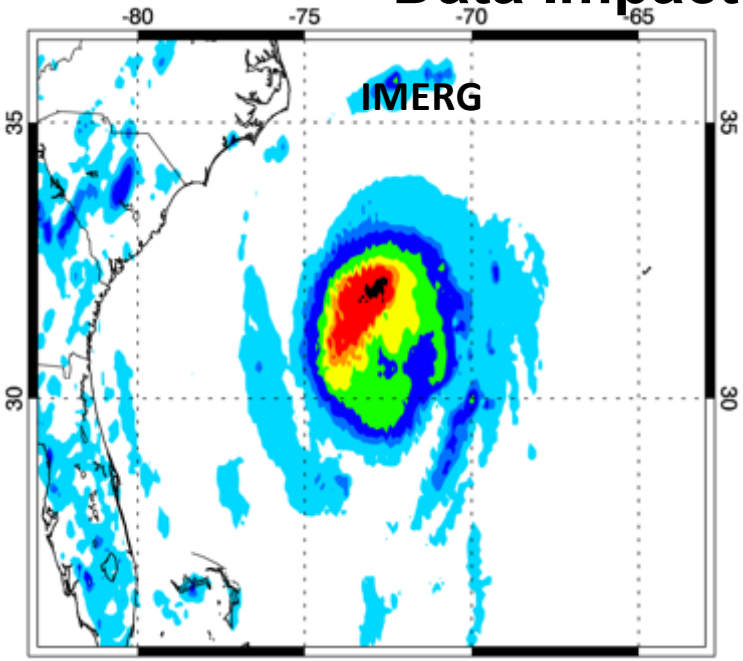


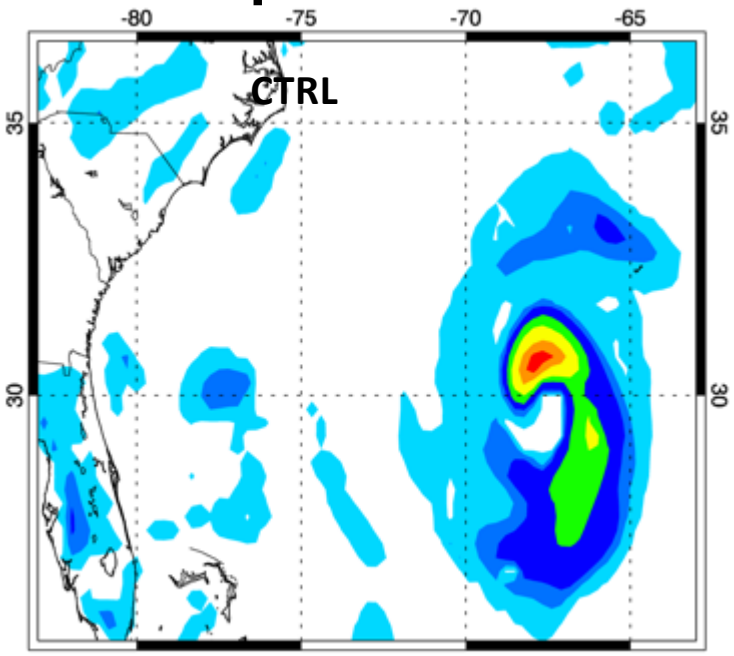


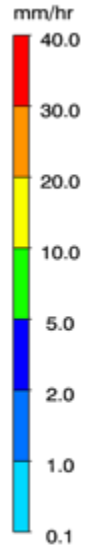
Data Impact – 1h Precipitation Rate Forecast



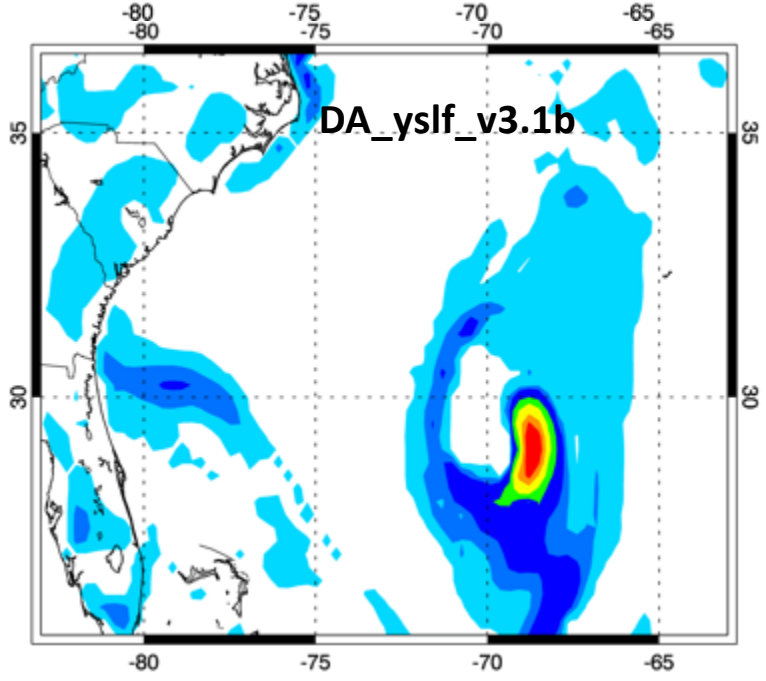
Data Impact – 1h Precipitation Rate Forecast

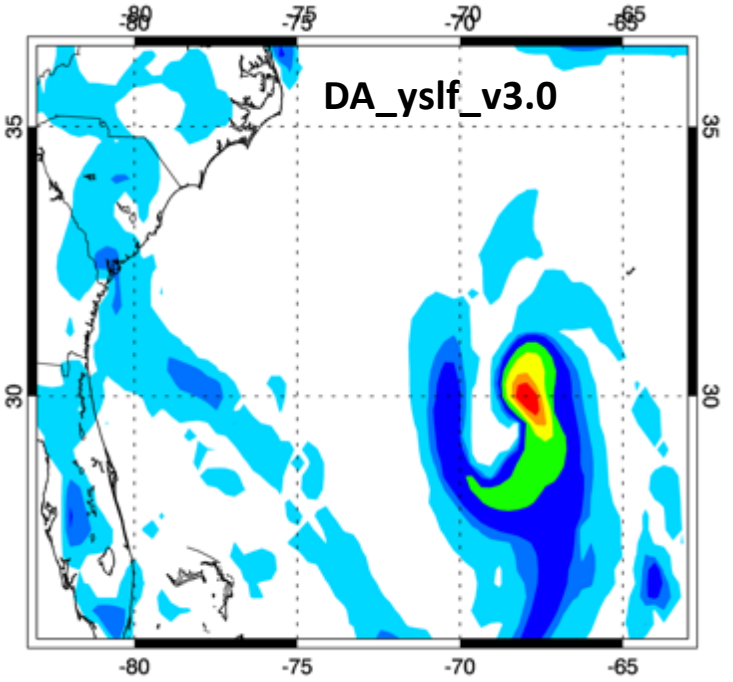


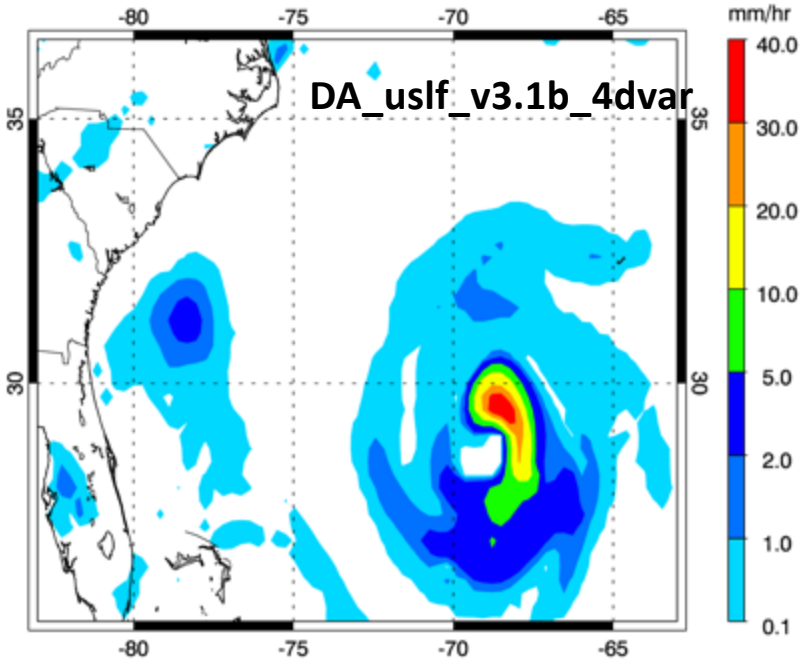




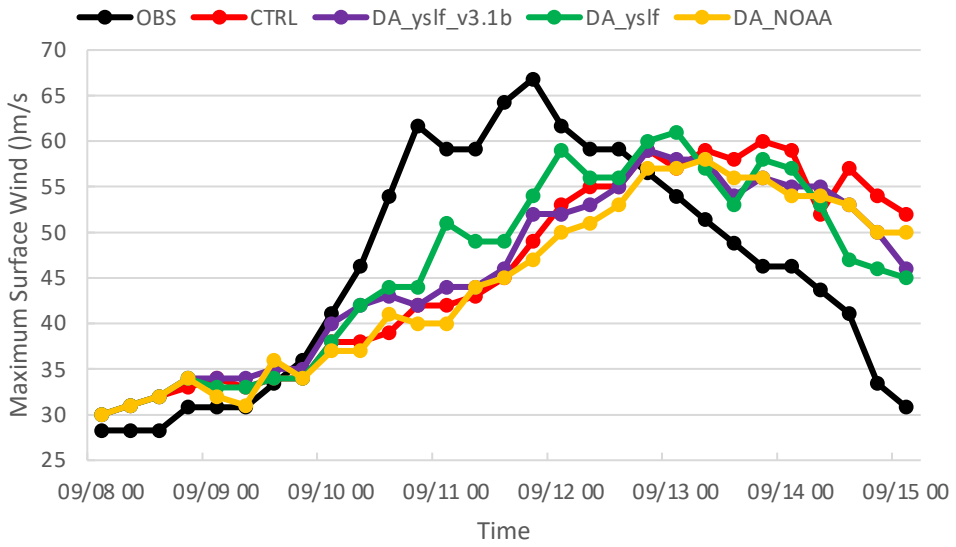
2100 UTC
12 September 2018



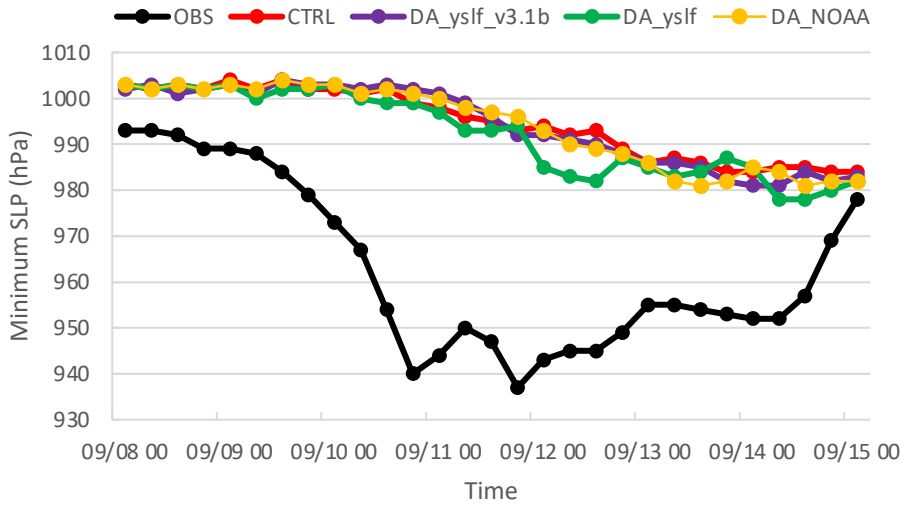




Data Impact - Intensity and Track



Maximum Surface Wind



Minimum Sea Level Pressure (hPa)

Track
00 UTC 09/08/2018 to
00 UTC 09/15/2018